LUNAR SCIENCE

Apollo Physicist Launches Noisy Dustup Over Old Moon Data

Whipping around the moon in the solar system's loneliest spaceship, Apollo 8 astronaut James Lovell saw something in 1968 that he shouldn't have: a gentle illumination, like a sunrise or sunset on Earth, hovered where the sun's light cast its sharp shadow on the moon's surface. Yet the moon has no atmosphere to catch the sun's rays and create such a spectacle.

Other astronauts and photos from Surveyor moon landers confirmed the horizon glow. So scientists hypothesized that lunar dust was picking up enough of an electric charge from cosmic rays or the solar wind to drive it tens of kilometers into the otherwise vacant lunar sky and cause the light show. A particle monitoring instrument, the Lunar Ejecta and Meteorites (LEAM) experiment, placed on the moon 4 years later seemed to provide corroborating data.

But now a former Apollo physicist is threatening to take the glow off this explanation. Brian O'Brien, who helped design dust monitors for Apollo 11, 12, 14, and 15, argues in a review published online recently by *Planetary and Space Science* that much of the LEAM data were not detections of charged lunar dust particles but instead electrical interference generated by the Apollo Lunar Surface Experiments Package (ALSEP) instruments parked 7.5 meters away from LEAM.

That claim has roused other Apollo scientists and engineers out of retirement. "I'm amazed that *Planetary and Space Science* accepted Brian's paper," says Lynn Lewis, the ALSEP systems manager and chair of a group trying to find missing data from the package.

The nostalgic dustup comes as NASA prepares for the 2013 launch of the Lunar Atmosphere and Dust Environment Explorer (LADEE), a lunar satellite whose instruments could resolve whether such charged particles exist and how they move above the moon. Many of the participants will face off at next month's 4th NASA Lunar Science Forum at Ames Research Park in California.

Lunar dust, and dust on other rocky planets and asteroids, is important to space exploration for several reasons. Researchers who count craters on airless, waterless bodies or analyze the chemistry of their rocky surfaces to try to estimate their age and composition need to know how much dust is flying around to calibrate measurements, says physicist Eberhard Grün of the Max Planck Institute for Nuclear Physics in Heidelberg, Germany, and the University of Colorado, Boulder. Dust creates practical problems, too. Surveyor 3, a robotic lander sent to the moon in 1967, showed signs of serious dust abrasion when it was collected 2 years later by Apollo 12 astronauts. Dust also darkened the moon explorers' suits, heating them beyond the cooling systems' capacity, and the particles' sharp, glassy edges caused leaks in the suits.

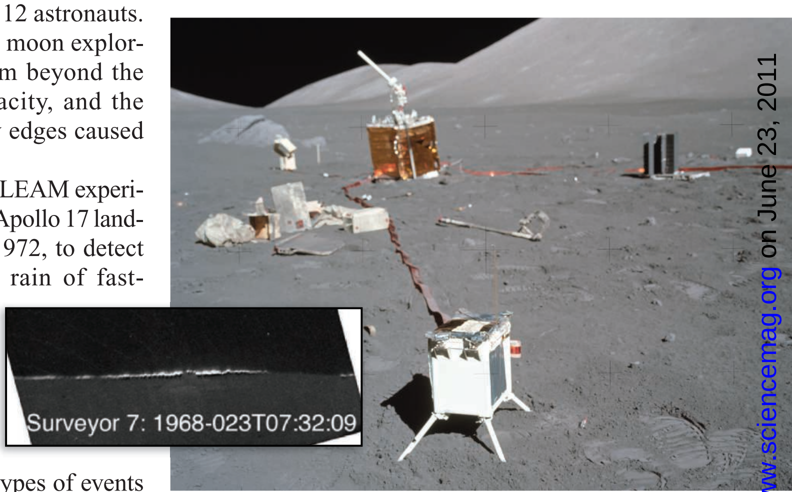
NASA designed the LEAM experiment, installed near the Apollo 17 landing site in December 1972, to detect a predicted continual rain of fast-moving micrometeorites and the fine lunar dust they kicked up upon impact. Yet LEAM recorded the most activity at lunar sunrise or sunset. The types of events recorded were odd as well: They saturated the instrument's sensors and lasted longer than they should have if caused by fast interplanetary particles.

Lunar scientists later concluded that LEAM was seeing slow-moving charged dust particles close to the ground. Perhaps as sunlight struck the moon and charged some dust particles but not neighboring ones still in the shade, the difference in electrical charges would drag lighter particles around the surface or even into the sky, they hypothesized. If such particles also floated kilometers higher, then the LEAM data might support the idea that the horizon glow was lunar dust.

But in his new paper, O'Brien, who was at Rice University in Houston, Texas, at the time of the Apollo missions, questions whether the LEAM data represent dust. For example, he says that too many of the unexpected signals arrive in well-ordered bursts to be from slow-moving, charged dust. He also points to reports of electrical interference in preflight laboratory tests of the instrument. Instead, O'Brien writes, the signals captured by LEAM occurred when ALSEP turned on or off the electricity for the heaters it needed to survive the lunar nights.

Lewis dismisses that idea. Electrical noise interference was the very first thing the LEAM team considered when the unexpected results came in, he says. And the team corrected for the interference between the lunar instruments found in the laboratory. O'Brien "paints a picture of these heaters cycling on and off and on and off, … but that's not the way it worked," Lewis says. The heaters turned on only once, at sunset, he says, and remained active through the night.

One of the technicians responsible for building LEAM, Derek Perkins, also rejects O'Brien's analysis. In an e-mail Lewis forwarded to *Science*, Perkins notes the results of a simulation using the backup LEAM instrument in 1976. In that study, Perkins simulated firing slow-moving, highly charged particles, similar to the lunar dust hypothesized to be responsible for the horizon glow, at the instrument and found a detection response similar to that of the Apollo 17 experiment.



Heater debate. The Apollo 17 LEAM instrument (*foreground*) was thought to have detected floating dust that could explain the lunar horizon glow (*inset*), but that may have been interference from heaters on nearby instruments (*background*).

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A conclusive answer to the LEAM debate may never come. The ALSEP data recovery group has located only a few months' worth of LEAM raw data so far. "It's sad that we don't have enough data in hand to really do the analysis," says physicist Mihály Horányi of the University of Colorado, Boulder. Horányi, who, as an editor of the lunar dust special issue of *Planetary and Space Science*, invited O'Brien to submit his review, is the principal investigator on a dust detector set to fly aboard LADEE. That experiment should detect any particles flying about 20 kilometers above the lunar surface. And if it works, lunar researchers may finally decipher what Lovell saw.

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